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ABSTRACT

Parents and educators have expressed fears that high noise levels in open space schools may interfere with academic achievement. This investigatien compared the reading ccmprehension of 60 fourth grade students in an open space school during periods both of quiet and of naturally occurring background noise. The reading tasks resembled normal classroom work and were administered by the teachers as part of the normal class routine. Noise levels during noise sessions averaged 13 decibels (A) higher than during quiet sessions; Despite this substantial difference, it was found that noise had no significant effect on accuracy or reading speed. (AUTHOR)

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THE EFFECT OF NOISE IN AN OPEN SPACE SCHOOL ON READING COMPREHENSION [1]

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The Effect of Noise in an Open Space School on Reading Comprehension

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Open space schools constitute the first major architectural departure from the traditional egg-crate building in one hundred years. They are often hailed as triumphs of design, hallmarks of our enlightened views of the learning process, and more economical as well. Yet to some parents, school board members, even professional educators, open space school means chaos and distraction. In more than one community, parental response has been vehemently negative and antagonistic, teachers and administrators have denounced their facilities as "unworkable," and walls have been erected as quickly as possible to alleviate "intolerable situations."

At the heart of the criticism is the issue of noise. Attitude surveys of teachers and students working in open space schools repeatedly report that excessive noise is one of the worst problems they encounter (Broward County School Board, 1972; Fitzpatrick & Angus, 1975; Pritchard & Moodie, 1971; Roper & Nolan, 1976; Spigel, 1974). Implicit in this complaint is the assumption that noise leads to distraction and poorer academic performance. Yet there is apparently no experimental study of open space schools which has attempted to test this assumption.

Unfortunately, the more general literature on noise and intellectual performance is also of little help. Research dating back as far as sixty years (Morgan, 1917) has produced inconclusive and often contradictory results (see Kryter, 1970). Furthermore, in an attempt to detect an effect, investigators have often resorted to highly structured, artificial, laboratory situations where

subjects perform under noises so intense as to be of doubtful relevance to educational settings. Slater (1968) is one of the few investigators to examine the effect of realistic school noise on students working on a relevant task. She compared seventh graders' performance on a reading and writing assignment in quiet, in an average classroom situation, and with loud but believable background noises. Data analysis revealed no noise effects, either detrimental or facilitating, on speed or accuracy of performance.

On the other hand, Bronzaft and McCarthy (1975) observed detrimental long-term effects of noise from an elevated train on the reading performance of students in a nearby elementary school. They suggest that two mediating variables may be responsible for this finding--loss of instructional time due to the interruptions from passing trains and the child's tendency to block out the relevant as well as the irrelevant sounds in a noisy environment. Both of these possibilities are supported by other research. Kyzar (1977) found that more than twice as much teaching time was lost in classrooms on the heavy traffic side of a school than on the opposite side. Cohen, Glass, and Singer (1973) demonstrated significant correlations between noisiness of a child's home environment and performance on an auditory discrimination test and between auditory discrimination and reading test scores. They concluded that repeated noise exposure leads individuals to filter out disturbing sounds; in the process, speech relevant sounds may also be screened out, subsequently affecting reading achievement.

The purpose of the present study was to determine whether the reading performance of students in an open space school is adversely affected by naturally occurring background noise conditions. The experiment was designed to maximize control over extraneous variables and to minimize any disruption of the normal school routine.

Method

Setting

The study was conducted in an upper-middle class suburban elementary school constructed in 1972. Approximately 345 students in grades one through five occupy one large carpeted room (14,859 sq. ft.). Each grade level works within a designated area, further subdivided into individual classrooms. All boundaries are defined by movable chalkboards, book cases, and storage cabinets. The teachers on each grade level work together as a team. Although each teacher has a "home room" group, students within the grade level regroup for various subjects. The school is well-organized and functions smoothly.

Subjects

The subjects were 60 fourth graders (28 boys, 32 girls) assigned to three equal-size home room classes. Each class contained students classified as low, average, and high-ability readers by their teachers. These designations generally reflected prior classification by the teachers. However, in order to achieve nearly equal numbers of the three ability groups, a few "borderline" subjects were re-classified for the purposes of the study. (Eighteen students were designated low-ability, 22 average-ability, and 20 high-ability.) With the exception of a few transfer students, the children had attended this school since kindergarten.

Reading Materials

In an effort to construct a reading task that was pedagogically meaningful and consistent with the students' normal school work, questions were chosen from materials already owned by the school (Specific Skill Series, Difficulty Levels B-F, Barnell Loft, Ltd., 1976). Two types of items were used--those in which students had to select the main idea of a paragraph from four choices, and those in which they had to use context clues to determine which of four words had been omitted from a sentence. Questions of each type were randomly selected from the

skill booklets and then randomly divided to form six tests of equal difficulty for each ability group (i.e. 18 tests in all). A typical test contained 20 questions of each type, in alternating order, and spanned several difficulty levels. The choice of items was intended to produce an error rate of approximately 25%.

Procedure

Since a major goal of the study was to investigate the effect of naturally occurring background noise, the experimenters met with the three fourth-grade teachers early in the school year to find out which time periods during the day were normally quiet and which were noisy. Noise measurements taken on several occasions during the succeeding weeks verified the teachers' subjective judgments. Testing sessions in both the morning and the afternoon were then planned to coincide with the noisiest and quietest times of the day.

A pre-test session, using trial versions of the materials, was conducted to familiarize students with the tasks and to determine the difficulty levels to be used in the final tests. The actual study was carried out over a three-week period. Each home room group participated two times a week, once in noise and once in quiet. Treatments (combinations of noise or quiet with time of day) were assigned to classes in different sequences to control for learning and for possible differences in performance during the morning and the afternoon.

During the quiet testing sessions, all three groups worked on the tasks simultaneously to minimize background noise. During the noise sessions, only one home room class participated at a time, while the other two classes continued with their regular school work. In general, only one testing session was conducted per day.

Each student worked on all six reading tasks constructed for his/her ability group. Within each group, tests were assigned to students

according to a Latin Square design, so that all tests were in use during each testing period.

In order to make all aspects of the investigation as natural as possible, the tasks were administered by the teachers, who introduced them as part of the normal class work without any indication to the students that this was an experimental situation. Students were given 20 minutes to work on the tasks. If they finished early, the teacher collected their papers and noted the time of completion on the top sheet.

Noise Measurements

Noise measurements were taken at 15 second intervals during all experimental periods. An investigator held an inconspicuous sound level meter as he or she walked casually along the inside edge of the participating group's instructional area. Measurements were started before the tasks were distributed and continued for a few minutes afterwards so as not to arouse suspicion.

Results

The median sound level readings for the three quiet and three noisy experimental sessions for each class are presented in Table 1. A clear separation between the two conditions was achieved, with noise periods being an average of 13 decibels higher than quiet periods. During quiet periods, the sound produced when a student turned a page of the reading task was clearly discernible; the noisy periods were characterized by teachers as "unsatisfactorily noisy." Another way of conveying the difference between these sound levels is in terms of standard figures for speech intelligibility. (U. S. Environmental Protection Agency, 1974). At 47 dbA, satisfactory conversation (normal voice, 95% comprehension) is maintained over distances of up to nine meters; at 60 dbA satisfactory conversation is limited to distances less than two meters.

Measures of reading performance for each ability group in quiet and noise are shown in Table 2. The data show that the tests did present an equivalent

degree of challenge to the different ability groups, producing an error rate close to the goal of 25%. It also appears from this table that neither accuracy nor speed were appreciably affected by the difference in conditions.

The data were examined statistically by an analysis of variance with a general linear model (Barr, Goodnight, Sall, & Helwig, 1976) used to calculate appropriate sums of squares. The variables ability group, pupil, test, teacher, week, time (morning vs. afternoon), and condition (noise vs. quiet) and the interactions ability group X teacher, test X teacher, time X condition, ability group X condition, ability group X time, and ability group X time X condition were entered explicitly into the model (115 df). The remaining interactions were pooled to form an appropriate error term (216 df). Using this model, the effect of noise on speed and on the error rates for both main idea and context questions was examined. The only condition effect to approach significance was the influence of noise on speed, $F(1, 215) = 2.93$, $p < .09$. During noise sessions students worked six percent more slowly. There were no significant condition by ability group interactions. Conclusions were unchanged when calculations were repeated using as the dependent variable the proportion of correct answers in the entire test rather than the proportion of correct answers in the material actually attempted.

Discussion

Despite the widespread concern over excessive noise in open space schools, the present study detected no adverse effect on performance, with the exception of a tendency to work more slowly in noise. This was true even though students were unaware that they were participating in an experiment, and presumably, were not trying to suppress any negative reactions to the noise, such as distraction and irritability. It appears that students are far better at ignoring background noise than is usually assumed. However, a caveat is in order. The present

study was conducted in a smoothly functioning school, with a generally motivated student body. The results are not necessarily generalizable to other schools where noise levels are more extreme and the students are less academically oriented.

Furthermore, comparison of the noise measurements gathered in this investigation with the speech intelligibility data suggests that noise may interfere with communication, even when performance is unimpaired. This issue should certainly receive attention in future research. In addition, studies must be conducted in many different types of open space schools, systematically varying noise levels and types of tasks. In the meantime, the present investigation should help to alleviate at least some of the concern that pupils in open space are unable to concentrate as well as they might in quieter conditions.

Table 1

Median Sound Levels (dbA) During Experimental Sessions

Class	Condition and Week					
	Noise			Quiet		
	1	2	3	1	2	3
1	60	62	61	45	46	49
2	56	66	58	47	48	49
3	55	60	61	45	46	48

Table 2

Reading Performance of Different Ability Groups in Noisy and Quiet Conditions

Ability Group	Performance Measure					
	Error rate on main idea questions (% wrong)[a]		Error rate on context questions (% wrong)[a]		Speed (questions/ minute)	
	Quiet	Noise	Quiet	Noise	Quiet	Noise
Low	18.7	18.8	22.2	22.9	3.18	2.75
Middle	21.2	21.0	15.9	19.9	2.68	2.58
High	22.7	22.9	26.3	24.2	3.03	2.82

[a] Error rates refer only to questions actually completed.

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